

Abstract

We propose to investigate short-range correlations (SRC) in inelastic electron scattering via the two proton knockout reaction ${}^3\text{He}(e, e'pp)n_{\text{sp}}$. Such correlations have a specific dynamical signature in the ground state wavefunction of the target nucleus which bridges the gap between nucleonic and quark degrees of freedom. As such, these measurements will provide severe constraints on existing theoretical models which employ realistic NN potentials, while, at the same time providing the impetus for new calculations.

Our objectives will be accomplished by measuring the cross section for this reaction on the low ω side of the quasi-elastic peak, i.e. at $x > 1$, as a function of the internal momenta of the target nucleus. It is generally acknowledged that the $(e, e'pp)$ channel is an excellent candidate for probing SRC, however, any experiment which aims to address this physics must be designed carefully in order to minimize competing processes. The key in our approach is to choose a kinematic region where meson exchange currents and isobar currents are expected to be minimal, and where the SRC signature is the cleanest and strongest. The optimal kinematical setting for such a measurement is that in which the two ejected protons egress nearly parallel and antiparallel, respectively, to the momentum transfer vector prior to absorption, and the energy transfer region lies on the lower side of the quasi-elastic peak, with the **missing momentum of the neutron confined to spectator values**. Thus, specifically, we are looking for an enhancement in the ${}^3\text{He}(e, e'pp)n_{\text{sp}}$ cross-section in these kinematics compared to what one might expect by combining ${}^3\text{He}(e, e'p)$ cross-sections with phase-space calculations of the pn recoil system. Such an enhancement is indicative of the presence of strongly correlated pp pairs in the initial ground state wavefunction.

The ${}^3\text{He}$ nucleus has been selected because it is the lightest nuclear system for which the reaction can proceed, realistic wavefunctions are available, and a triple coincidence renders the experiment kinematically complete.

We propose to carry out these measurements using the two high resolution spectrometers in Hall A for detecting the scattered electron and the forward proton. The second proton will be detected using the soon-to-be-commissioned BigBite spectrometer. We request 240 hours of beamtime at a beam current of 100 μA .